BRIEFER ARTICLES.

THE TRANSPIRATION OF SPARTIUM JUNCEUM AND OTHER XEROPHYTIC SHRUBS.

(WITH TWO FIGURES)

IT seems to be somewhat generally taken for granted that shrubs of decidedly xerophilous character, with early deciduous leaves and highly developed green cortex, must depend mainly on the latter for photosynthesis.

Grisebach makes the statement in regard to *Spartium junceum* L.: "At certain seasons this shrub develops little isolated leaves; these are of no physiological value whatever."[1] Kerner says of the leaves of the same shrub: "But these are of such secondary importance that their green tissue can form only the smallest portion of the organic substances necessary to the further growth of the plant, and this duty chiefly falls to the share of the cortex of the switch-like branches."[2] Other authors are less explicit in regard to the uselessness of the leaves of Spartium, but dwell much on the activity of the cortex.

Without more apparatus than was at my command it was not possible for me to investigate the relative amount of photosynthetic work done by the leaves and the cortex respectively. But it was a comparatively easy matter to ascertain the relative amount of transpiration accomplished by the leaves and by the cortex of the slender branches and twigs.

Young vigorous branches were taken and compared, two by two, until a pair of almost precisely equal area of cortex were obtained. This was not a difficult matter, as the form of all the branches is so nearly alike. One branch was then stripped of its leaves, and the scars left by their removal covered with melted beeswax, to which 5 or 10 per cent. of olive oil had been added, to lower the melting point. The freshly cut, larger ends of the branches were then submerged in water in test-tubes, which were fitted with corks, each with a double perforation, to admit the branch and a capillary tube for air to supply the

[1] GRISEBACH, Die Vegetation der Erde, Tchihatchef's French translation, 1:411. Paris. 1877. The German original is not to be had in Naples.

[2] KERNER, Pflanzenleben, Oliver's translation, 1:330. N. Y. 1895.

place of absorbed water. Tube and branch were then sealed into the cork with the beeswax mixture, and the leafy and the leafless branch thus arranged were placed out of doors for some hours in full sunshine, after being carefully weighed. Reweighing at the end of the period gave the loss of water.

On April 5 the leaves had not attained their full size, but nearly so, and were in excellent condition for the experiment. A branch 40^{cm} long had twenty-three leaves, with a total area (reckoning one surface only) of 17.5^{sqcm}. The area of the branch with its four twigs, was about 51.8^{sqcm}.

In three hours of sunshine, at a temperature in the shade of 20 to 22° C., the leafless branch lost 1.32^{gm} water and the leafy one 2.47^{gm}. The probable loss of water through the leaves of the leafy branch was therefore $2.47 - 1.32$ or 1.15^{gm}. Ratio of $\frac{\text{loss by leaves}}{\text{loss by stems}} = \frac{1.15}{1.32} = 0.87$. The ratio of the loss by unit area of the leaves to that by unit area of the stems would therefore have been about 0.87×3 or 2.61. It should be noted, however, that the upper epidermis of the leaves of Spartium contains a good many stomata and doubtless performs a considerable part of the work of transpiration, so that the value 2.61 is somewhat too large.

A repetition of the experiment on April 13, when the leaves had practically attained their full size (except in the case of a few at the tips of the branches), gave a loss of 3.24^{gm} for the leafy branch and 1.15^{gm} for the leafless one. The branches were for three hours in full sunlight at a temperature of 22° C. during most of the experiment.

The relative amount of transpiration performed by the leaves and the green cortex of this shrub is evidently not necessarily a measure of the relative amount of photosynthetic work. But it would seem probable that, since the leaves excrete a much larger amount of watery vapor in proportion to their area than the cortex does (and sometimes a larger total amount), they must also fix more of the carbon dioxid admitted to the tissues of this plant than the cortex does.

Some indirect evidence points very strongly in the same direction. Most of the growth of the Spartium in the neighborhood of Naples takes place between February 1 and July 1. I have no detailed numerical statement to make on this head, since the idea of taking measurements for the purpose did not occur to me until too late in the season. But two years' observation has made me sure of the fact above stated. Leafy individuals examined June 1 show branches 50^{cm} long

which have reached these dimensions since February. The leaves of the shrub first appear in considerable numbers about February 1, and they begin to turn yellow, preparatory to falling, about June 1. During the comparatively rainless period from late June until late September, the growth of the leafless shrub is extremely slight, and its obvious activity is almost wholly in the direction of growing and ripening the fruit.

In corroboration of the view that the photosynthetic work of this

FIG. 1.—Part of a leafless shrub of Spartium, photographed July 1. It has borne no leaves for a year, but has blossomed and is fruiting.

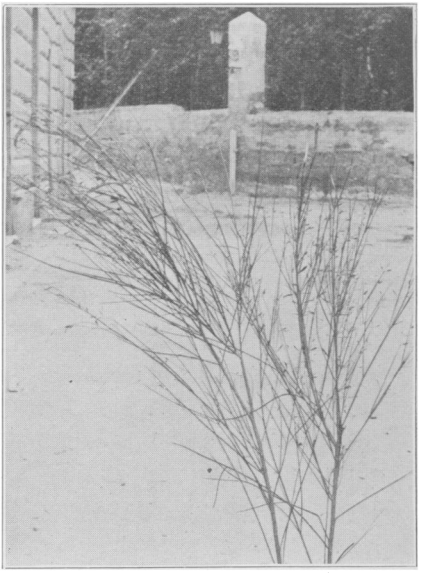

FIG. 2.—Part of a leafy shrub of Spartium, photographed July 1. The leaves are on the point of falling. It has borne hardly any flowers or fruits.

plant is done largely in the leaves, may be given the additional fact that some individuals produce no leaves or hardly any during certain years. Whether there is any alternation of leaf producing and leafless years for the same individual, I do not know. Now the leafless plants, at the end of May and beginning of June, when their neighbors are in full leaf and growing with great rapidity, are found to have made hardly any growth during the entire spring. But the leafless specimens often bear many flowers, and the leafy ones are comparatively flowerless. A glance at the accompanying figures will give some idea of the relative appearance of the two sorts of shrubs.

Time has not permitted the examination of the amount of transpiration accomplished by the leaves of the whole number of summer deciduous shrubs which occur in this region. Two of the most important species are *Calycotome villosa* Link and *Cytisus scoparius* Link. The former ot these gave on two successive days, with different specimens each day 2.6 times and 3.3 times as much loss from leafy as from leafless branches. The latter on different days and with different specimens gave 3.5 times and 3.1 times. These experiments were conducted exactly like those with Spartium.

My conclusions may be briefly summarized as follows:

1. In the three species examined, *during the leafy season*, the relative power of transpiration of the leaves as compared with that of the cortex is much greater, for equal areas.

2. During the leafy season, the total transpiration due to leaves may be more than three times as great as that due to cortex.

3. Photosynthetic work due to leaves is probably much greater during the leafy season and perhaps for the entire year than that due to cortex.

4. Leafless individuals of Spartium grow but little at any season.—JOSEPH Y. BERGEN, *Naples, Italy.*

GEASTER LEPTOSPERMUS: A CORRECTION.

IN the number of the BOTANICAL GAZETTE for October last, page 306, in the technical description of *Geaster loptospermus* Atk. & Coker, n. sp., occurs a typographical error in lines 14 and 22, the μ being used in place of mm. The measurements in these lines should read 3–4.5^{mm} and 2.5–3.5^{mm}. In the general text the measurements were properly given, the error occurring only in the technical description.—GEO. F. ATKINSON, *Cornell University.*